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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER

ROCCHEGIANI, RENZO

ART UNIT PAPER NUMBER

2825

DATE MAILED: 09/27/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/452,844

Applicant(s)

RAAIJMAKERS ET AL.

Examiner

Renzo N. Rocchegiani

Art Unit

2825

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 03 July 2002.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,3-30,33-35 and 55-63 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☐ Claim(s) 1,3-30,33-35 and 55-63 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)


- 1) ☐ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 20. 6) ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1, 3-4, 8, 20-26, 30, , 35, 55 and 63 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent N. 5,650,351 (Wu) in view of U.S. Patent N. 4,058,430 (Suntola et al.).

Wu discloses a process to form a capacitor having a bottom 3-D folding electrode over a substrate comprising a trench, the electrode defining a volume and being connected via a metal line (Fig. 11). Wherein the bottom electrode is covered by HSG hemispherical grains, with a high dielectric layer formed over the grains (Fig. 11), the dielectric layer comprising one or more films of nitrides and or oxides, including metal oxides (col. 7, lines 15-20) with a total thickness that falls between 20 and 300 Angstroms (col. 7, lines 19-21).

Wu does not disclose layering the dielectric layer by depositing a set a mono-layers using alternating chemistries.

Suntola et al. teaches the formation of a dielectric layer by reacting the surface first with a first reactive species to form a first layer, then reacting the newly formed layer with a second reactive species to form a second layer, and to continue this

process to form as many layers as desired with the desired chemistries so as to form a dielectric layer of a preferred thickness (Abstract).

It would have been obvious to one having ordinary skill in the specific art to combine the teachings of Suntola et al. with the invention disclosed by Wu since, Wu discloses a highly dielectric layer and Suntola et al. teach a process to form a dielectric layer that will have a high dielectric constant.

3. Claims 5-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent N. 5,650,351 (Wu) in view of U.S. Patent N. 4,058,430 (Suntola et al.) and in further view of U.S. Patent N. 4,747,367 (Posa).

As stated in paragraph 2, all the limitations of these claims have been met except for teaching the use of a carrier gas and the purging the chamber after the formation of each mono-layer.

Posa teaches the operation of a chamber during the formation of multiple thin layers, wherein a carrier gas is mixed with the reactant gases and wherein each reactant gas is completely purged before the introduction of the next reactant gas (cols. 4 & 5).

It would have been obvious to one having ordinary skill in the specific art to combine the teachings of Posa with the Wu and Suntola et al. since, Posa teaches that by using a carrier gas and purging the chamber of a reactant gas before introducing the next reactant gas will minimize what Posa refers to as "dead space" (col. 3, lines 10-15).

4. Claims 9, 11-14, 28, 29, and 56-59 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent N. 5,650,351 (Wu) in view of U.S. Patent N. 4,058,430 (Suntola et al.) and in further view of U.S. Patent N. 6,090,659 (Laibowitz et al.).

As stated in paragraph 2, all the limitations of the claims have been met except for specifying that the reactant gases used to form the mono-layers comprise two metal species such as Ti, Al, Nb, and oxygen so as to form a dielectric layer with a dielectric constant greater than 20.

Laibowitz et al. teaches a method to form a dielectric layer over a semiconductor substrate by depositing mono-layers using reactant gases used to form the mono-layers comprise two metal species such as Ti, Al, Nb, and oxygen so as to form a dielectric layer with a dielectric constant of approximately 50. (col. 2, lines 55-67).

It would have been obvious to one having ordinary skill in the specific art to combine Laibowitz et al. to Suntola et al. and Wu since, Wu teaches the use of tantalum oxide desiring to obtain a high dielectric constant material and Laibowitz et al. teaches other materials that may be used so as to have a very high dielectric constant material layer.

It would also be obvious to one having ordinary skill in the specific art to form a metal nitride and to oxidize the previously layered material since, Wu already discloses forming a nitride also by forming an oxide layer over a previously formed layer inherently involves the oxidation of the previously formed layer.

5. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent N. 5,650,351 (Wu) in view of U.S. Patent N. 4,058,430 (Suntola et al.) and of

U.S. Patent N. 6,090,659 (Laibowitz et al.) and in further view of U.S. Patent N. 6,200,897 (Wang et al.).

As stated in paragraph 4, all the limitations of the claim have been met except for teaching the deposition of a dielectric layer using a metal, silicon and an oxygen containing gas.

Wang et al. teach a CVD of a dielectric material using silicon, a metal and an oxygen containing gas (col. 2, lines 21-26).

It would have been obvious to one having ordinary skill in the specific art to combine the teachings of Wang et al. to the invention disclosed by Wu, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. *In re Leshin*, 125 USPQ 416.

6. Claims 15 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent N. 5,650,351 (Wu) in view of U.S. Patent N. 4,058,430 (Suntola et al.) and of U.S. Patent N. 6,090,659 (Laibowitz et al.) and in further view of Ritala et al. ("Zirconium dioxide thin films deposited by ALE using zirconium tetrachloride as precursor" *Applied Surface Science*, 1993, pp. 333-340).

As stated in paragraph 4, all the limitations of the claims have been met except for teaching the deposition of the dielectric layer using a metal halide with an oxygen containing gas wherein there occurs a ligand exchange reaction with the oxygen containing species.

Ritala et al. teach the mono atomic layer deposition of a metal oxide such as Zirconium Oxide wherein a metal halide such as Zirconium tetrachloride, is reacted is an oxygen containing gas.

It would have been obvious to one having ordinary skill in the specific art to combine Ritala et al. to the Wu since, such a deposition process results in a layer with a more uniform thickness (Ritala et al.). Also, it is inherent that there will be an exchange of ligands since the two gasses react with each other

7. Claims 33, 34 and 61 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent N. 5,650,351 (Wu) in view of U.S. Patent N. 4,058,430 (Suntola et al.) and in further view of Ritala et al. ("Zirconium dioxide thin films deposited by ALE using zirconium tetrachloride as precursor" Applied Surface Science, 1993, pp. 333-340).

As stated in paragraph 2, all the limitations of the claims have been met except for teaching the deposition of the dielectric layer using a metal halide with an oxygen containing gas wherein there occurs a ligand exchange reaction with the oxygen containing species.

Ritala et al. teach the mono atomic layer deposition of a metal oxide such as Zirconium Oxide wherein a metal halide such as Zirconium tetrachloride, is reacted is an oxygen containing gas.

It would have been obvious to one having ordinary skill in the specific art to combine Ritala et al. to the Wu since, such a deposition process results in a layer with a more uniform thickness (Ritala et al.). Also, it is inherent that there will be an exchange of ligands since the two gasses react with each other.

8. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent N. 5,650,351 (Wu) in view of U.S. Patent N. 4,058,430 (Suntola et al.) and of U.S. Patent N. 6,090,659 (Laibowitz et al.) and in further view of Kukli et al. ("Atomic Layer Epitaxy Growth of Tantalum Oxide Thin Films from Ta(OC₂H₅)₅ and H₂O" The Electrochemical Society, 1995, pp. 1670-74).

As stated in paragraph 4, all the limitation of the claim have been met except for teaching the deposition of a material that is self-terminated by organic ligands.

Kukli et al. teach the deposition of mono atomic dielectric layer that is self terminated by organic ligands.

It would have been obvious to one having ordinary skill in the specific art to combine Kukli et al. to Wu since, this process will form a smooth surface with uniform thickness (Kukli et al.).

9. Claims 18, 19, 60 and 62 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent N. 5,650,351 (Wu) in view of U.S. Patent N. 4,058,430 (Suntola et al.) and in further view of Kukli et al. ("Atomic Layer Epitaxy Growth of Tantalum Oxide Thin Films from Ta(OC₂H₅)₅ and H₂O" The Electrochemical Society, 1995, pp. 1670-74).

As stated in paragraph 2, all the limitation of the claim have been met except for teaching the deposition of a material that is self-terminated by organic ligands, the material comprising tantalum or aluminum, wherein the deposition temperature is less than 350 degree C, and wherein the metal precursor is a metal ethoxide compound.

Kukli et al. teach the deposition of mono atomic dielectric layer that is self terminated by organic ligands wherein the precursor is a metal ethoxide comprising tantalum or aluminum, such ethoxide being reacted with an oxygen containing vapor at a temperature of less than 350 degree C.

It would have been obvious to one having ordinary skill in the specific art to combine Kukli et al. to Wu since, this process will form a smooth surface with uniform thickness (Kukli et al.).

10. Claim 27 is rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent N. 5,650,351 (Wu) in view of U.S. Patent N. 4,058,430 (Suntola et al.) and in further view of Watanabe et al. ("A New Cylindrical Capacitor Using Hemispherical Grained Si (HSG-Si) for 256Mb DRAMs", IEDM 1992, pp. 259-262).

As stated in paragraph 2, all the limitations of the claim have been met except for teaching the formation of a cylindrical electrode.

Watanabe et al. teaches the formation of an electrode with HSG grains over it, wherein the electrode has a cylindrical shape.

It would have been obvious to one having ordinary skill in the specific art to form a cylindrical capacitor structure since, a capacitor with such a shape will be denser (Watanabe et al.).

Response to Arguments

11. Applicant's arguments filed on July 3, 2002 have been fully considered but they are not persuasive. Applicant argues that the above rejection is improper because there

is not motivation to combine the art. In support of this statement the applicant presents a number of arguments that will be addressed in order in this section.

First the applicant argues "it has been generally understood in the art that high k dielectric layers are not compatible with silicon bottom electrodes" (page 3 of applicant's argument) and that because "the general state of the art . . . teaches away from depositing a high k dielectric layer on polysilicon" (page 4 of argument) there would be no motivation to combine Wu with Suntola. Further, even though applicant understands that the combination of Wu and Suntola is to render ALD deposition obvious, applicant argues "the Examiner must show why the skilled artisan would select this isolated teaching of Wu [to deposit high k dielectric over HSG], rather than all the other high k references" (page 4 of argument). To this first point the examiner rebuts that there is no requirement to show why a person with general skill in the art would choose one material versus another when both are disclosed in the main reference. The examiner directs applicant's attention to MPEP § 706.02(j) where it is outlined the contents of a 35 U.S.C. 103 rejection. In this section of the MPEP it is stated that the examiner is to explain "why one with ordinary skill in the art at the time the invention was made would have been motivated to make the proposed modification." MPEP § 706.02(j). In this section the term "proposed modification" refers to those teachings explicated in the secondary reference and not the primary reference. In the present rejection the use of a high k dielectric material over the HSG is disclosed in the primary reference, therefore there does not need to be a showing of motivation to follow the disclosure because no modification is being made. The Wu reference discloses depositing high k dielectric

over the HSG, this is all that is necessary to anticipate this one limitation. The Suntola reference is only to show that it would be obvious to deposit the high k dielectric material disclosed by Wu, by way of ALD.

Applicant's second argument also refers to the disclosure of using a high k dielectric in the Wu reference. Applicant argues that excluding the reference to Wu, no other prior art teaches depositing a high k dielectric over HSG, and thus there is evidence of a "long-felt but unresolved need". Applicant presents this argument based on case law that discusses "long-felt need" and "difficulties encountered" by those skilled in the art. The examiner understands the point made by the Federal Circuit court that proof of long felt need and difficulties encountered in the prior art may serve in determining the novelty of an invention. Further, the examiner does not debate whether other prior art teaches or not the deposition of high k dielectric over HSG. The examiner argues that the primary reference used in the rejection, i.e. the patent to Wu, does disclose the deposition of high k dielectric over HSG. Showings that other prior art does not teach this step then becomes evidence to support the novelty of the invention disclosed in the reference to Wu. Applicant also argues that because in the Wu reference the teaching of depositing a high k dielectric layer over HSG is only disclosed once, the examiner should overlook such disclosure. The examiner would like to remind applicant that just as applicant looks at the prior art as a whole, each reference should be read and considered in full. The examiner is unaware of a minimum number of citations requirement in order for a teaching to be valid as a proof of non-novelty.

Thus, each teaching disclosed within each reference, whether mentioned once or more times, is evidence of lack of novelty.

Applicant further argues that motivation to combine the Wu reference with the Suntola reference is not supported by the simple fact that the Suntola reference has been known for 20 years. The examiner has never argued this point. The Suntola reference being 20 years old is just to show that one with ordinary skill in the art would know of its teachings. The motivation behind combining the two references is based on the disclosure of the Wu reference, that states that a thin layer of high k dielectric material is being deposited, coupled with the teachings of Suntola, that state ALD is an efficient method to deposit thin films of high k dielectric material. In other words Wu discloses a particular preference that is specifically addressed by Suntola. It would thus be obvious to one with ordinary skill in the art to turn to Suntola with the knowledge obtained from the Wu reference.

For the above reasons the examiner has not been persuaded by applicant's arguments and has decided to maintain the rejection presented. Because no new grounds of rejection have been presented, the examiner has decided to make this action final.

Conclusion

12. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within

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TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Renzo Rocchegiani whose telephone number is (703) 308-5839. The examiner can normally be reached on Monday through Friday from 8:30 am to 4:30 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Smith, can be reached at (703) 308-1323. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9318.

RNR

September 16, 2002



MATTHEW SMITH
SUPERVISORY PATENT EXAMINER
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